time, we must accept the photographic evidence that the meteors are very small—that they are, over the area of $2° \times 2°$, fainter than 17th magnitude, or over 230° area, fainter than 15th magnitude stars.

I am willing to try again to photograph the swarm during a period extending from December 24 this year to the end of the first week in April next year, provided an ephemeris is computed for the purpose; for I am impressed with the idea that the luminosity, and accurate position of this swarm in its orbit, ought, if possible, to be determined with the necessary accuracy, and the photographic method only can adequately furnish the data.

A Revolver Eyepiece, electrically warmed. By A. F. Lindemann.

Especially in observing double stars and planetary details I had often and rapidly to change the magnifying power of my telescope. The air would allow a power of 100; suddenly it becomes steadier for a few seconds and a power of 200 to 300, or even 420 to 600, can be used with my 6-inch glass. But before 1895 it took me 15 to 30 seconds to change it, and during this time the air often changed unfavourably, and I had to return to 100. Quite apart from having perhaps to focus the changed power a little, to light up and take my eye off the telescope, and spoiling by change of illumination the sensitiveness of the retina for the next 5 to 10 seconds, in winter—or even in a very damp and cool summer night—the new cold eyepiece, when in position, just at the most important moment, would suddenly cover with condensed moisture from the eye, and a wiping process had to be resorted to. Even when the eyepiece was previously warmed, it often cooled down during observation, and gave the same deplorable result. This induced me to construct and make an eyepiece which I have now had over three years in constant use, and which proves to be all that can be desired. The idea of a revolver eyepiece is not a new one, as at least one "vertically" revolving eyepiece exists; but my construction may have some new features, and may be of use to others as it has been to me; and the (I believe) novel idea of warming by electricity should certainly prove a boon to nearly every observer, as it can easily be applied to any telescope.

The revolver eyepiece (figs. 1, 2, 3, 4, and 5) consists of a ring (a) of ebonite (which I largely use with advantage), to which is screwed the ebonite carrier (b). The ring and carrier is slipped over the tube (A), usually carrying the eyepieces (figs. 1 and 2) up to collar (c). By this the position of A in relation to $a\,b$ is fixed. The clamp screw (e) holds it tight in any position by pressing a small steel plate (d) in the usual way against A. When e is released $a\,b$ can be rotated round A. Upon A is very carefully

Fig. I.

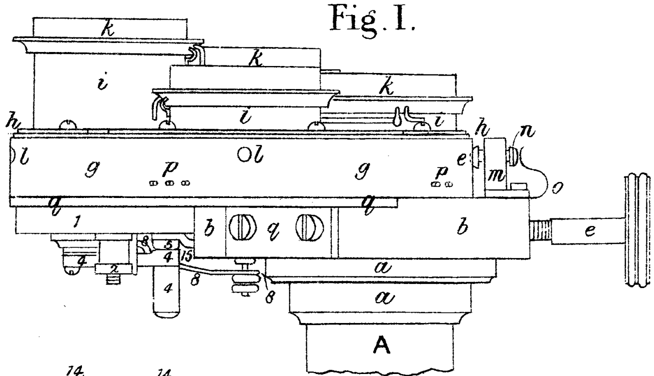


Fig. II.

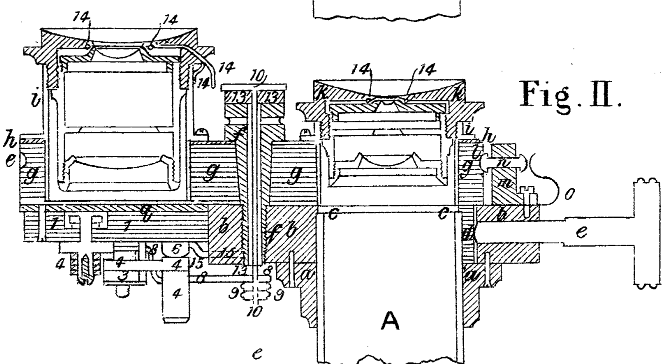


Fig. III.

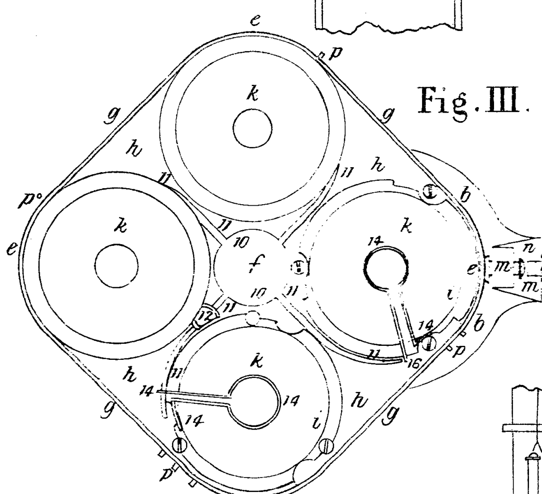


Fig. V.

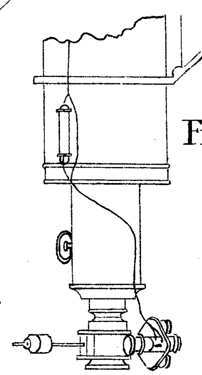
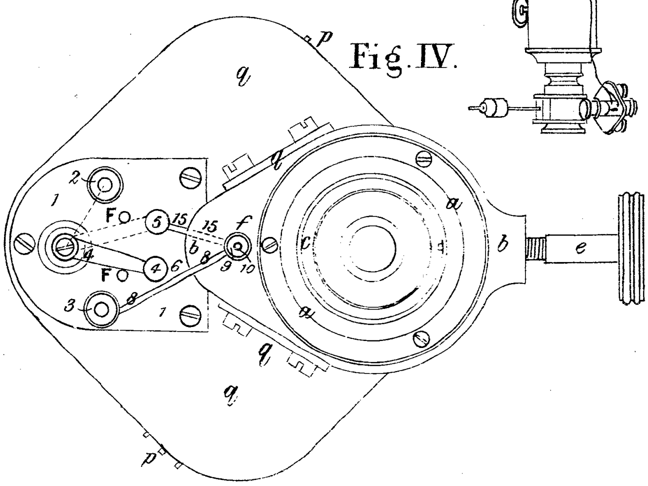


Fig. IV.



fixed the ebonite piece (g) by means of a cone and screw (f). g rotates, and is for convenience' sake made square, with rounded corners. I choose this shape so that the eye can easily be brought over the eyepiece. Even a pentagon disturbs the bringing up of the eye, as the nose and eyebrows are in the way. The piece g is in four places, and at right angles to one another, carefully pierced, so that the centres of the eyepieces to be inserted are in the same circle, central to f, and in the optical axis of the telescope. In these holes are inserted the eyepieces ($i\,i\,i\,i$) of various magnifying powers, and at such varying heights that the focus of all of them is in the same plane. The eyepieces fit smoothly in the holes and are fixed as seen in the drawings (figs. 1, 2, and 3), being held by turning them under the screw heads as shown. In turning g one power after the other is placed exactly over $a\,b$, and the power changed within half a second.

Now as to details. At m there is a slip-bolt (n), rounded off towards g, against which it presses by a spring (o). In g conical holes (l) are drilled, so that when the bolt (n) falls in one, the respective eyepiece is exactly over the centre of A; the telescope is now focussed, and the star having been set in centre of one eyepiece will be found to stand also in the centre of this or any other which may be set. The small resistance given by the bolt against turning enables the hand to feel that the eyepiece is in position. At $p\,p\,p$ are fastened near the corner, and convenient for the hand to feel, small rounded pins, which in the dark tell, by the number of them felt, what power is in hand, so that any power can be determined and easily set. An aluminium plate ($q\,q$) is fastened to b so as to protect the eyepieces from beneath against injury and dust, and is at the same time the carrier of the commutator (1).

Now as to warming. This is at present done by electricity from the primary battery, but in future will be supplied by a central storage battery. At 1 is fixed to the above-mentioned aluminium plate (q) a small commutator, 2 and 3 are the two pole clamp screws, 4 is the contact lever. The current travels along the telescope tube by covered wires to a resistance coil (fig. v.) with variable resistance, and from thence by a pliable silk-covered copper strand to 2 and 3. 2 is connected by a thick silver wire (15) to the screw foot (f). From 3 a thick hard-drawn silver wire (8) stretches to and round the thick silver wire (10), where it rests by spring action against the silver nut (9) set fast by check nut. This wire (10) passes through the ebonite plug and plate (13 . 13), inside screw and cone ($f\,f$) to the top of it, ending in plate 10, which itself stretches out in four arms (11 . 11 . 11 . 11). Fixed to $g\,g$ is the aluminium plate $h\,h$, making good contact with the head of $f\,f$, and with the tubes of the eyepieces ($i\,i\,i\,i$). By these means pole 2 is connected with all eyepiece tubes. The other pole (3) ends in the four arms (11 . 11 . 11 . 11) of thick hard-drawn silver wire, bent according to height of eyepiece as needed, and flattened at the ends, and taking the pole (3) close to the four

eyepiece tubes. The eyepiece has a head of ebonite, which screws into the eyepiece tube. This head is pierced by a thin platinoid wire (14 . 14) towards the centre, where it forms a ring and returns to the outside, where one end is bent short and flattened, making good spring contact with the tube *i* by means of a short silver strip soldered to *i*, and thereby connects pole 2. The other end of 14 stretches a little further out, and is bent sharply downwards and flattened, making good contact with the wire (11), which presses it outwards by spring action, and is therefore connected with pole 3. The eyepiece (fig. III.) on the right is to show it out of circuit, and that by turning it to the left and bending the wire 11 towards the wire 14 it will catch it and set the eyepiece for warming (see lower eyepiece in fig. III.). To insert another eyepiece, turn the one to be taken out about 10° to the right, lift it out, and fix the other by turning it the other way.

The action is the following (dotted lines show connection of commutator parts): To turn the current on, place handle 4 upon 5; current runs from 2 to 4 and 5, by 15 to screw *f* to plate *h* to four eyepieces (*i i i i*), to platinoid wires (14 . 14 . 14 . 14), from thence to arms 11 . 11 . 11 . 11 to centre (10), down to 9 and 8 and to pole 3. By this arrangement the circuit remains unbroken, although *g* is rotating. When electricity is turned on and resistance regulated, the four platinoid rings are gently warmed, and by radiation the four eyepiece lenses next to the eye are also warmed in a few minutes, so that condensation of water upon them is impossible. Before constructing this warming arrangement I considered well the effect of warming upon the eyepiece lens, but the effect is practically nil, especially as the heating is central and gentle, as it only requires a few degrees to prevent dew deposit. I have not determined the current required, as I had plenty of it, but it is of course a very simple matter for anybody to work out. It must, however, be considered that the current splits at 10 in four parts. I find the platinoid gives a very good resistance. The sliding resistance makes the regulation very simple and perfect. Perfect contacts and careful insulation of wires are of course most important; especially platinoid wires (14 . 14) must be kept well away from brass setting of lens. I have other methods for warming, but found this one the most simple and convenient, as the eyepiece can be released and exchanged in less than ten seconds. When using more than four powers it is, however, more practical to have two or three sets of four, each ready and connected to the respective wires, as the whole set can then be exchanged in less than ten seconds. I may mention that the head of the clamp screw, eyepiece tubes, commutator handle, and counter weight are painted with Balmaine's paint, also a ring round A and *a*: this helps greatly when exchanging, saves one's head, and the eye finds at once the eyepiece, no other illumination being required.

Advantages.

1. Four different powers can be used in rapid succession of half-second each, thereby making use of every fraction of time of perfect air. In this way I separated *ω Leonis* to perfection on 1895 February 28, during a fine night. But the 5 to 10 seconds of absolutely perfect vision could only be gained by this or a similar instrument, or in the ordinary way accidentally.

2. Eight to twelve powers are at disposal in sets of four each, with intervals of less than 10 seconds for each set.

3. The eyepieces are always in focus if one eyepiece is once set for colour of object.

4. The eye need not be removed from eyepiece during change of powers.

5. The revolver allows a sweep over the whole field of the object glass in any direction, a very considerable advantage, especially with higher powers. I usually set it by *e* to sweep in R.A., and then turn 90° and sweep in declination; very convenient when searching for an object of which ephemeris is not quite exact. In this way I found Brooke's Comet.

6. The very objectionable condensation is entirely obviated.

Disadvantage.—Perhaps slightly complicated, and extreme nicety in construction imperative.

I have the first eyepiece I made in use since 1895 January 16, and learned to value it more and more every starlight night. Professor Schiaparelli and Professor Max Wolf were very pleased with this instrument, especially the latter, who is himself no mean mechanic, who worked with it, and photographed it at Sidmouth in October 1896, and strongly recommended me to publish the above description of it.

Sidmouth Observatory:
March 25, 1898.

Times of Transit of the Zero Meridians of the two adopted Systems across the centre of the illuminated disc of Jupiter, 1897–98. By A. C. D. Crommelin.

In compliance with numerous requests I have computed the following list of the times of transit of the zero meridians across the centre of the illuminated disc of *Jupiter*. Those passages are given which occur next after noon on those days for which the longitude of the central meridian at noon was given in my previous ephemerides. Thus five rotations intervene between the tabulated transits, except in the case of those marked with an asterisk, which are separated from those preceding them by four rotations only. Intermediate passages can be found either by interpolation, or, with sufficient accuracy for most purposes, by applying to the nearest transit in the tables once or twice the